

1920A

Frequency Counter

Instruction Manual

P/N 400101
November 1977



WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

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If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.
2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

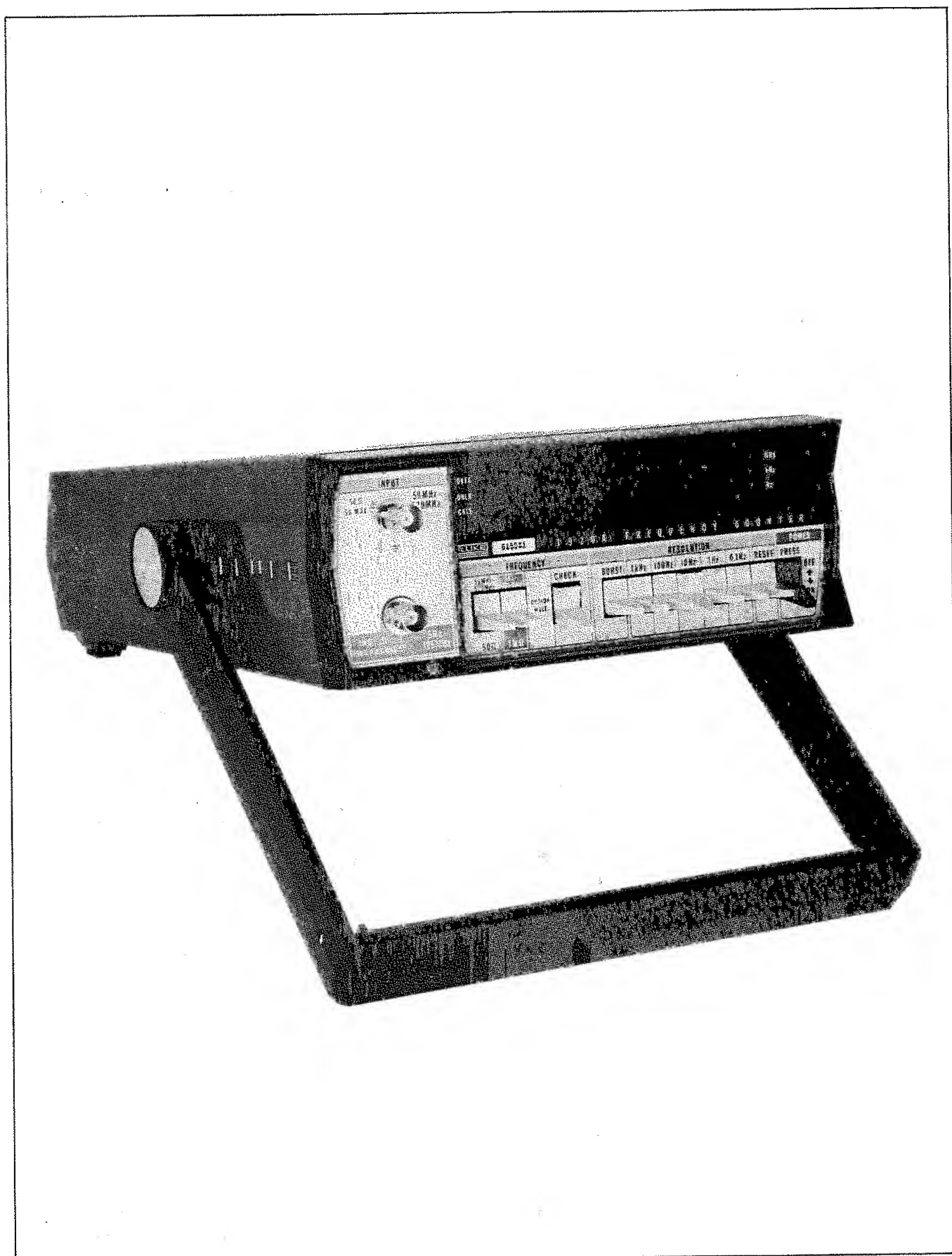
The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC., will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX 43210, MOUNTLAKE TERRACE, WASHINGTON 98043. ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, Washington 98043

1920A



Model 1920A Frequency Counter

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 1920A Digital Counter is a 5 Hz to 520 MHz (to 1 GHz or 1.25 GHz, optional) counter designed primarily for telecommunications applications. The unit is compact and lightweight making it fully portable and suitable for field use. An optional battery-operated version of the counter permits use at remote or mobile installations where AC line power is unavailable.

1-3. The display is nine digits, light-emitting-diode (LED) type with leading-zero suppression and automatic decimal point positioning. Display resolution is front-panel selectable at 1 kHz, 100 Hz, 10 Hz, 1 Hz or 0.1 Hz. Annunciators are provided to indicate the measurement unit (i.e. MHz, kHz, or Hz) and also overflow when the capacity of the display is exceeded. All displayed measurement data is provided by an optional Data Output Unit (DOU, Option -02).

1-4. Input sensitivity for the 1920A is better than 15 mV rms and AGC is incorporated to provide stable operation. Extremely low-level signals which cannot be reliably measured, fall below the AGC threshold and are ignored by the counting circuitry. A "burst" mode is provided to permit the measurement of keyed RF signals having a duration of two milliseconds or greater. The display is automatically held at zero if the RF burst is of shorter duration than the selected gate time (resolution).

1-5. The 1920A also incorporates an optional high-resolution mode (Option-06) to permit the measurement of low frequency signals, such as signalling tones, while using conveniently short gate times. In this mode, input signals in the range of 10 Hz to 10 kHz are multiplied by a factor of 1000 allowing the use of shorter gate times for better resolution.

1-6. A self-check mode of operation is also provided to verify proper overall performance of the digital circuitry and the display of the unit prior to use.

1-7. Several options are available with the Model 1920A. Each is listed by option number in Table 1-1. Accessories are listed and described in Table 2-1. Desired options must be specified at time of purchase. A detailed description of each option is included in Section 6, Options and Accessories.

Table 1-1. Available Options

OPTION	NAME	INSTALLATION	
		FACTORY	CUSTOMER
-01	Battery Pack*	YES	YES
-02	Digital Output Unit*	YES	YES
-04	Superior Txco	YES	NO
-06	Multiplier, Resolution	YES	NO
-13	1 GHz Prescaler	YES	NO
-14	1.25 GHz Prescaler	YES	NO

*Kits Available

Table 1-2. 1920A Accessories

ACCESSORY MODEL NO.	DESCRIPTION	PART NO.
A53	Antenna, extendable whip.	382762
C89	Case, Carrying	446803
MOO-200-625	Rackmount kit	390468
2010A-7023	Printer Interface kit	410472

1-8. Power requirements for the 1920A are 100, 115 or 230 volts at 50 to 400 Hz for the line-powered version. Model 1920A-01, is equipped with rechargeable nickel-cadmium batteries which provide a minimum of three hours (1.5 hrs. with -13 or -14 Option installed) of operation. The battery-powered unit also operates from the AC power line, and at the same voltages as the line-powered instrument.

1-9. The standard time base TCXO has an aging rate of $\pm 3 \times 10^{-7}$ /month and $\pm 2 \times 10^{-6}$, 0°C to 50°C. An optional

TCXO (Option-04) provides an aging rate of $\pm 3 \times 10^{-7}$ /month and $\pm 5 \times 10^{-7}$, 0°C to 50°C. In addition, an external time base signal of 1 MHz, 5 MHz or 10 MHz may be connected via a rear-panel BNC connector.

1-10. SPECIFICATIONS

1-11. Pertinent specifications for Model 1920A are listed below (See Table 1-3). Several options and accessories are available for use with the 1920A. Physical dimensions of the unit are shown in Figure 1-1.

Table 1-3. Model 1920A Specifications

FREQUENCY MEASUREMENTS

RANGE:

Direct	5 Hz to 125 MHz with AGC
Prescaled	50 MHz to 520 MHz with AGC

BURST MODE:

Frequency Range	1 MHz — 520 MHz
Burst Duration	25ms plus gate time selected

GATE TIME:

Direct	1ms, 10ms, 0.1s, 1.0s, 10s
Prescaled	4ms, 40ms, 0.4s, 4.04s, 40s (520 MHz)

INPUT CHARACTERISTIC

SENSITIVITY:

Direct	15 mV up to 100 MHz decreasing to 25 mV at 125 MHz
Prescaled	15 mV to 520 and 1000 MHz

OVERLOAD:

Direct	150 V rms up to 1 kHz decreasing to 5V rms at 125 MHz
Prescaled	5 Vrms, fuse protected

TIME BASE STABILITY

	Standard	-04 Option
FREQUENCY	10.0 MHz	10.0 MHz
AGING RATE (PER MONTH)	$< \pm 3 \times 10^{-7}$	$< \pm 3 \times 10^{-7}$
TEMPERATURE STABILITY		
0°C to 50°C	$< \pm 2 \times 10^{-6}$	$< \pm 5 \times 10^{-7}$
20°C to 30°C	$\pm 5 \times 10^{-7}$ typ	$\pm 2 \times 10^{-7}$ typ
LINE VOLTAGE		
($\pm 10\%$ change)	$< \pm 1 \times 10^{-7}$	$< \pm 5 \times 10^{-8}$

Table 1-3. 1920A Specifications (Cont)

EXTERNAL TIME BASE INPUT

FREQUENCY REQUIRED MHz, 5 MHz, or 10 MHz
(Wired for 10 MHz at Factory)

SENSIVITY 100 m Vrms

IMPEDANCE 2k Ω , 40 pF

INPUT IMPEDANCE

DIRECT 1M Ω /30pF

PRESCALED 50 Ω , VSWR 2.5: 1 max

BURST MEASUREMENT Measures frequency of RF burst is approximately 2.0ms.
This allows for signal settling. Display is automatically reset
to zero if burst width is less than the gate time selected.

GENERAL

DISPLAY 9 digits LED, leading zero suppression time between successive measurements is 200 ins, plus gate time.

ANNUNCIATION (INDICATOR LED's) OVFL (Overflow) MHz
UNLK (Unlock) kHz
GATE Hz

OPERATING TEMPERATURE 0°C to +50°C (operating)
0°C to +40°C (during charging with option -01)
-40°C to +60°C (storage)

POWER REQUIREMENTS 115/230V \pm 10%, 100V AC available
50 to 400 Hz; 15 watts typical.

LINE POWER FUSES 1/4A AC-line version, 1/2 slo-blo battery version

DIMENSIONS/WEIGHT

Width (max)	228.6mm	(9.0 in.)
Height (max)	80.3mm	(3.16 in.)
Depth	335.3mm	(13.2 in.)
Weight (approx)	2.7 kg	(6 lbs.)
Weight with Batteries (approx)	3.6 kg	(8 lbs.)

BATTERY, RECHARGEABLE OPTION -01**NICKEL CADMIUM**

Discharge Time Min 3 hrs (1.5 with -13 or -14 Option installed) after full charge time.
Charge Time 14 hrs (unit not turned on) 56 hrs (unit turned on.)

NOTE: Batteries should be fully discharged and recharged occasionally to maintain good long term usefulness.

Table 1-3. 1920A Specifications (Cont)

DATA OUTPUT OPTION—02

8-4-2-1 BCD output from each digit, plus encoded decimal point and units annunciation information. All outputs are CMOS Low Power TTL compatible, "HIGH" true. Print command is provided.

SUPERIOR TCXO, OPTION —04

FREQUENCY 10 MHz

AGING RATE (per month) $< \pm 3 \times 10^{-7}$

TEMPERATURE STABILITY

0 — 50°C $< \pm 5 \times 10^{-7}$

20 — 30°C $\pm 2 \times 10^{-7}$ typ

LINE VOLTAGE

($\pm 10\%$ change) $< \pm 5 \times 10^{-8}$

RESOLUTION MULTIPLIER, OPTION —06

FREQUENCY OPERATING RANGE 10 Hz — 10 kHz

GATE TIME 1 ms (1 Hz resolution)
 10 ms (0.1 Hz resolution)
 100 ms (.01 Hz resolution)
 1s (.001 Hz resolution)
 10s (.0001 Hz resolution)

1 GHz PRESCALER, OPTION —13

FREQUENCY RANGE 50 MHz to 1 GHz

INPUT IMPEDANCE 50Ω VSWR 2.5: 1 max

OVERLOAD 5V, fuse protected

GATE TIMES 8 ms, 80 ms, 0.8s, 80s

1.25 GHz PRESCALER, OPTION —14

FREQUENCY RANGE 50 MHz to 1.25 GHz

INPUT IMPEDANCE 50Ω VSWR 2.5: 1 max

OVERLOAD 5V, fuse protected

GATE TIMES 8 ms, 80 ms, 0.8s, 80s

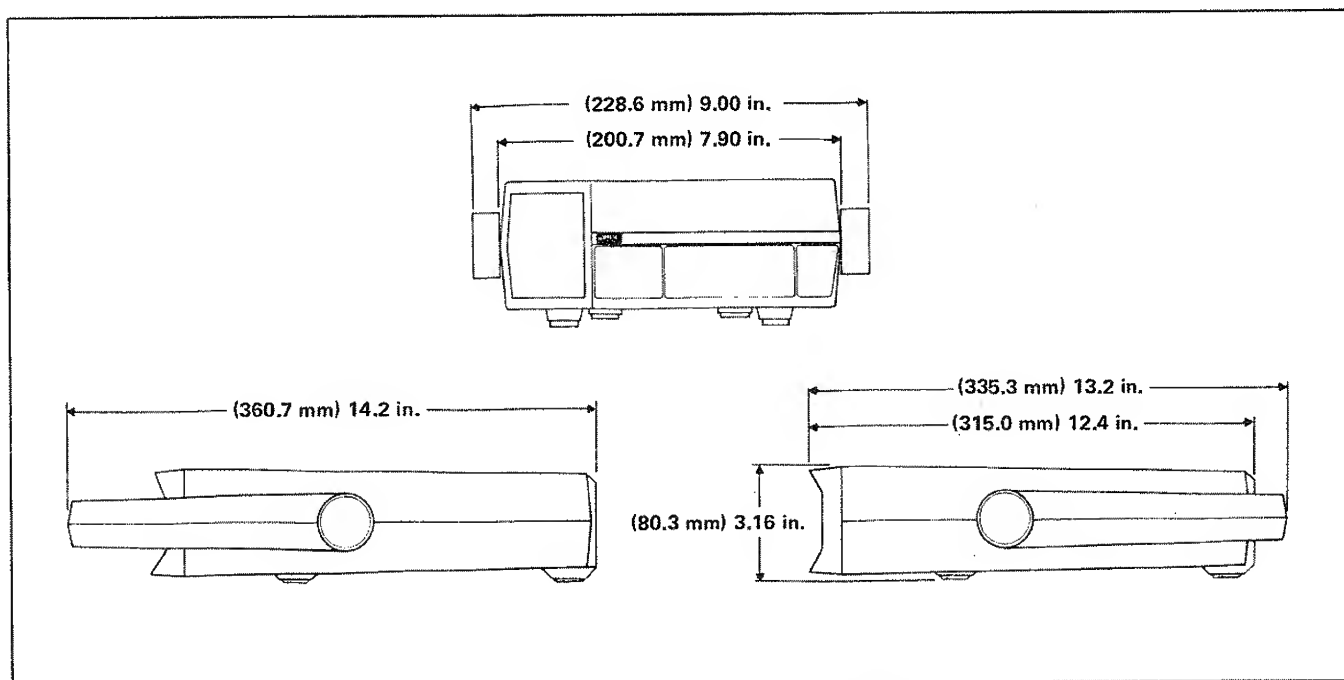


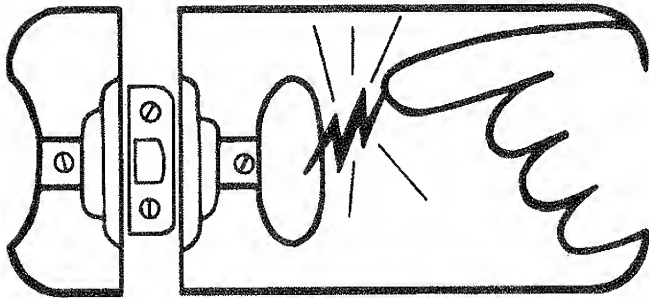
Figure 1-1. Model 1920A Outline Drawing



static awareness



A Message From
John Fluke Mfg. Co., Inc.



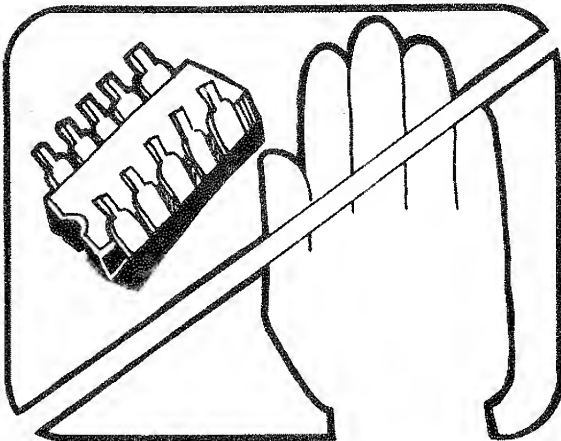
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

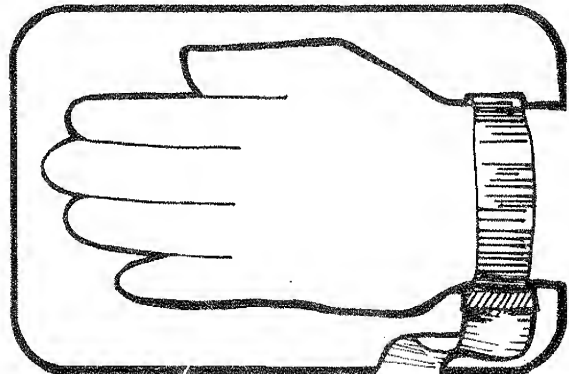
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol



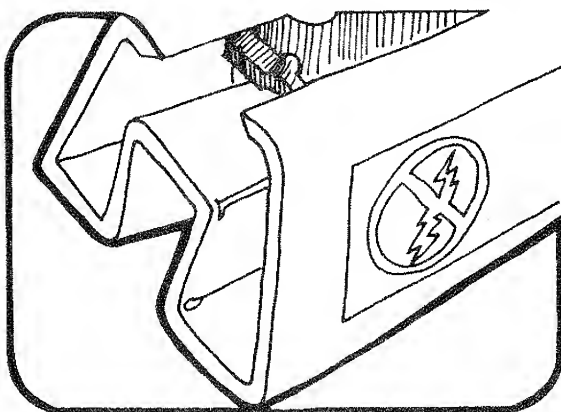
The following practices should be followed to minimize damage to S.S. devices.



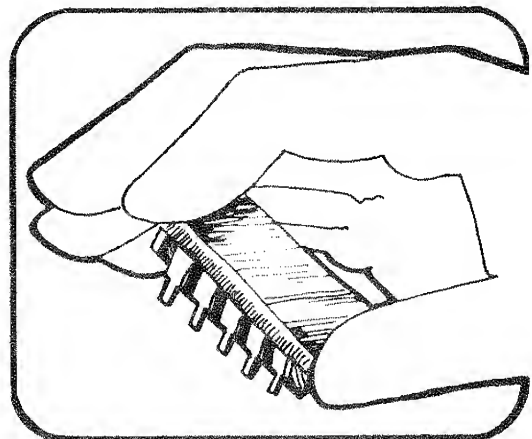
1. MINIMIZE HANDLING



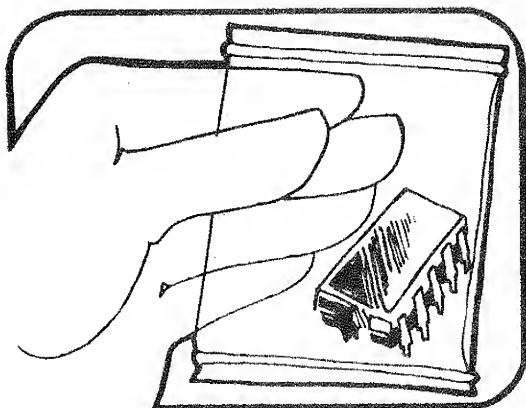
3. DISCHARGE PERSONAL STATIC
BEFORE HANDLING DEVICES



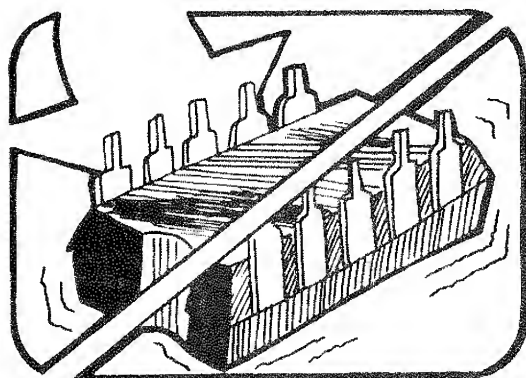
2. KEEP PARTS IN ORIGINAL CONTAINERS
UNTIL READY FOR USE.



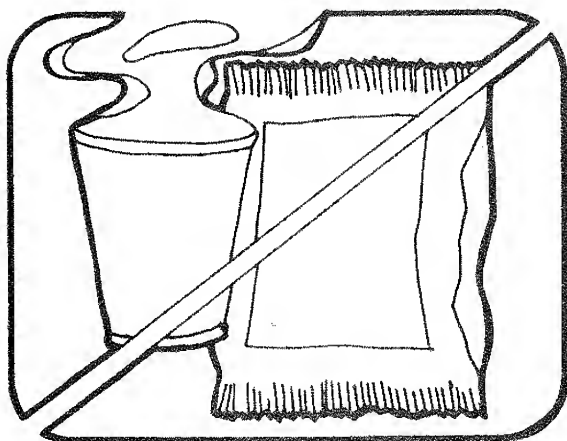
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT

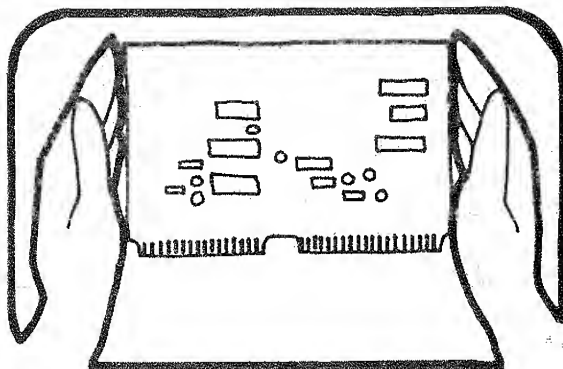


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

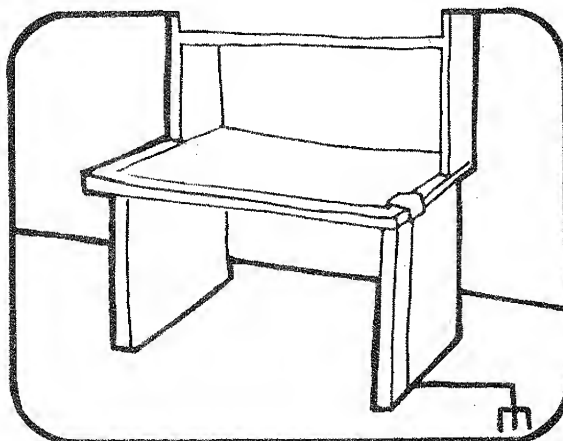


7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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AND GENERAL DYNAMICS, POMONA DIV.



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet	Wrist Strap
30"x60"x60 Mil	P/N TL6-60
P/N RC-AS-1200	\$7.00
\$20.00	

Section 2

Operating Instructions

2-1. INTRODUCTION

2-2. This section contains operating information for the Model 1920A. The contents of this section should be read before operating the counter. Should any difficulties arise during operation of this instrument, please contact your nearest John Fluke Sales Representative, the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, Wash. 98043, Telephone (206) 774-2211. A list of Sales Representatives is given in Section 7.

2-3. SHIPPING INFORMATION

2-4. The Model 1920A is packaged and shipped in a protective container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage.

2-5. If reshipment of the equipment is necessary, the original container should be used. If the original container is not available a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the equipment model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. Both the line-powered and battery-powered versions of the Model 1920A can operate from either a 115V or 230V ac power line. Before connecting the power line, ensure that the line power selection switch is in the position which corresponds to the power line voltage. The power selection switch is located on the Main PCB; refer to Section 4 for access instructions.

2-8. RACK INSTALLATION

2-9. The Model 1920A may be center-mounted in a standard 19-inch rack when supplied with the appropriate

rack mounting kit. Instructions for installing units in the rack mount are supplied with the rack mounting kit. The center rack mounting kit is Model No. MOO-200-625.

2-12. OPERATING FEATURES

2-13. The location and function of all controls, indicators and connectors are shown in Figure 2-1 and described in Table 2-1.

2-14. OPERATING NOTES

2-15. The following paragraphs describe various conditions which should be considered for operating the 1920A.

2-16. AC Line Connection

2-17. The rear-panel, three-prong, U-ground connector permits the 1920A to be connected to either 100, 115 or 230V ac, 50 to 400 Hz line power. The offset prong on this connector is connected to the 1920A chassis and should be connected, via the power cord, to a high quality earth ground.

2-18. OPERATION

2-19. Turn-On Procedures

2-20. Use of the following procedure is suggested for initial turn-on of the 1920A. With reference to the previous paragraphs turn on the 1920A as follows:

1. Install available options as required.
2. Connect the 1920A to line power (see paragraph 2-17).
3. Press ON/OFF Power switch.

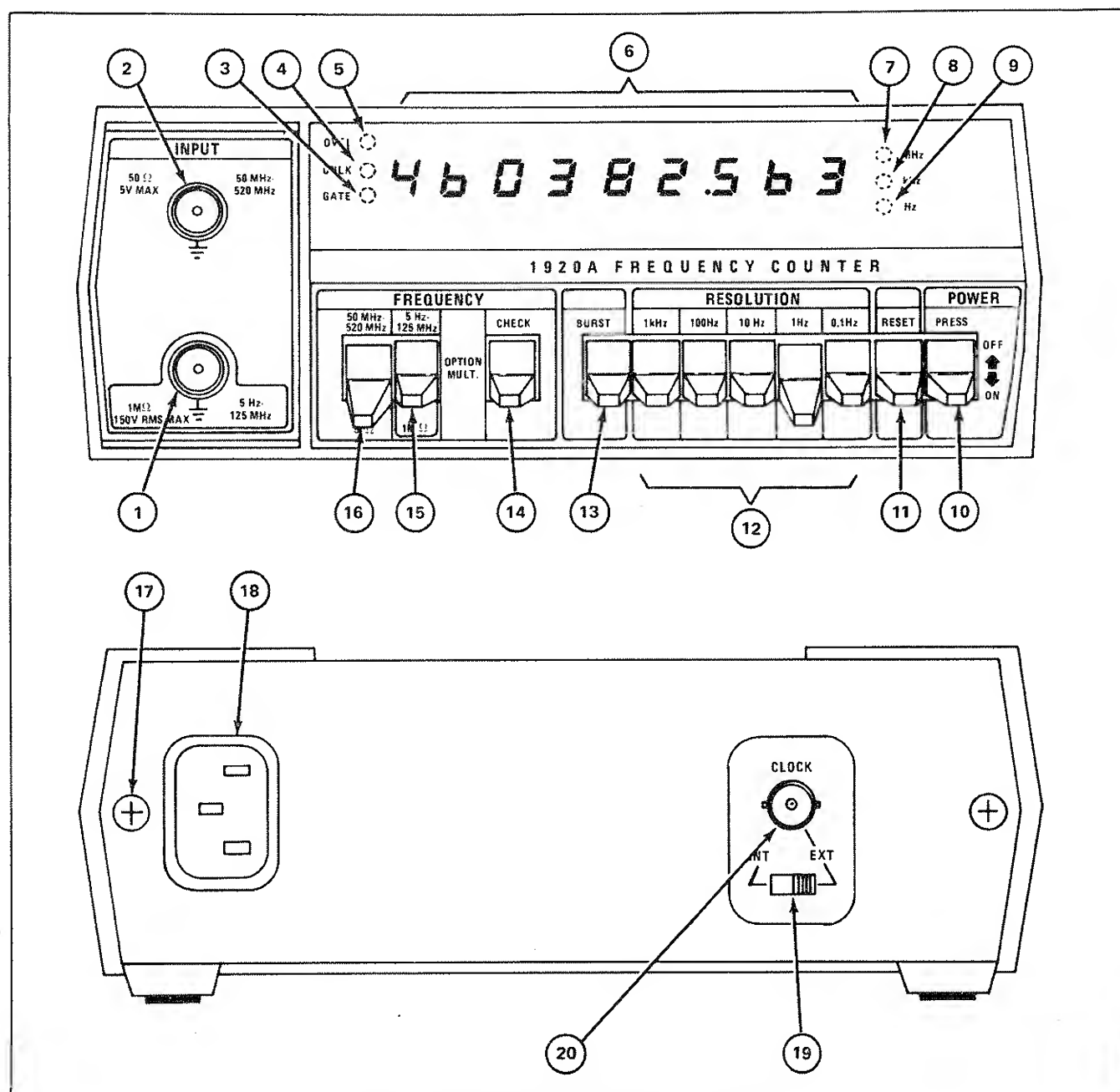


Figure 2-1. Control and Indicator Locations

Table 2-1. Control and Indicator Functions (Cont)

ITEM NO.	NAME	FUNCTION
1	5 Hz – 125 MHz 1 MΩ BNC connector	Provides connection to the direct (non-prescaled input of the counter for signals in the range of 5 Hz to 125 MHz.
2	50 MHz – 520 MHz 50Ω BNC connector	Provides connection to the prescaled input of the counter for signals in the range of 50 MHz to 520 MHz on the standard unit (50 MHz to 1 GHz and 50 MHz to 1.25 GHz are available with Options –13 and –14 respectively).

Table 2-1. Control and Indicator Functions

3	Gate Lamp	Lights to indicate a measurement is being made.
4	UNLK Lamp (Option —06), (UNLOCK)	Part of Option—06, Lights when the x1000 frequency multiplier (high resolution) function is selected and the frequency multiplier has not yet achieved phase lock-up, giving an ambiguous display.
5	OVFL Lamp, (OVERFLOW)	Lights to indicate that the display capacity has been exceeded due to selection of fine resolution (long gate time).
6	Display LED's	Display consists of nine digits. Leading zeros are suppressed.
7	MHz Lamp	Lights to indicate display is reading MHz.
8	kHz Lamp	Lights to indicate display is reading kHz.
9	Hz Lamp	Lights to indicate display is reading Hz.
10	POWER Switch	A push-push switch to energize the counter.
11	RESET Switch	A piano-key switch, when pressed, resets the counter to zero and initiates another measurement. When pressed with CHECK function selected, causes all correctly operating display segments to illuminate.
12	RESOLUTION Switches	A series of five switches to select the desired measurement resolution. For example, if 10 Hz Resolution is selected, the least significant digit (LSD) represents 10 Hz.
13	BURST Switch	A piano-key switch to select the Burst mode of operation which measures keyed RF bursts.
14	CHECK Switch	A piano-key switch to select the Self-Check mode of operation.
15	5 Hz—125 MHz 1 M Ω Switch	A piano-key switch to select the direct (non-prescaled) input for measurement of signals in the range of 5 Hz to 125 MHz.
16	50 MHz — 520 MHz 50 Ω Switch (50 MHz—1 GHz or 50 MHz — 1.25 GHz)	A piano-key switch to select the prescaled input for measurement of signals in the range of 50 MHz to 520 MHz (50 MHz to 1 GHz, Option—13 or 1.25 GHz, Option—14.
17	Retaining Screw	Philips-head screw attaching case to instrument chassis.
18	Power Connector	Provides connection through line cord to AC power line.
19	INT/EXT Switch	Slide switch to select either the internal timebase or an external time-base signal applied to the CLOCK Connector.
20	CLOCK Connector	Provides for connection of an external timebase signal of 1 MHz, 5 MHz or 10 MHz (depending on internal jumper configuration) when the INT/EXT switch (see item 21) is placed in the EXT position.

2-21. Turn-Off Procedure

2-22. The turn-off procedure consists of setting the ON/OFF Power Switch to the OFF position, by first pressing down and then releasing.

2-23. Operating Functions

2-24. The following paragraphs describe the self-check, frequency measurement, direct mode, prescaler mode, burst mode, external timebase, and give procedures necessary to operate the 1920A for each.

2-25. SELF-CHECK MODE

NOTE

The following procedure assumes a 10 MHz timebase. Substitute appropriate readings if a 1 MHz or 5 MHz external timebase is being used.

2-26. The self-check mode provides a means of verifying proper overall operation of the counter, excluding the direct input amplifier, the prescaled input amplifier and the high resolution multiplier. To self-check the unit, proceed as follows:

1. Press the Power switch to the ON position.
2. Press the CHECK switch.
3. Press the RESET switch. All display segments should light. The display should read 88888888.
4. Press the 1 kHz RESOLUTION switch. The display should read 10.000 MHz \pm 1 digit.
5. Press the 100 Hz RESOLUTION switch. The display should read 10.0000 MHz \pm 1 digit.
6. Press the 10 Hz RESOLUTION switch. The display should read 10000.00 kHz \pm 1 digit.
7. Press the 1 Hz RESOLUTION switch. The display should read 10000.000 kHz \pm 1 digit.
8. Press the 0.1 Hz RESOLUTION switch. The display should read 10000.0000 kHz \pm 1 digit.

2-27. FREQUENCY MEASUREMENTS

2-28. Signals to be measured by the Model 1920A are applied to either one of two BNC input connectors mounted on the left side of the front panel. The direct input (lower connector) accepts signals in the range of 5 Hz to 125 MHz. The prescaled input (upper connector) accepts signals in the range of 50 MHz to 520 MHz. The input impedance of the

direct input is 1 Megohm shunted by less than 30 pF, while the prescaled input is 50 ohms.

2-29. Direct Mode (Color Coded Blue)

2-30. The 5 Hz to 125 MHz input is used in the direct measurement mode. This input is protected from overload to withstand inputs as high as 150 Volts rms at frequencies below 1 kHz without damage. Overload capability decreases from 150 Volts rms at 1 kHz to 5 Volts rms at 125 MHz.

2-31. To make frequency measurements in the direct mode, proceed as follows:

1. Connect the input signal to the lower front panel BNC connector.
2. Press the 5 Hz - 125 MHz switch.
3. Select the desired resolution, read the measurements on the display and note the unit of measurement (i.e., MHz, kHz).

2-32. Prescaled Mode (Color Coded Yellow)

2-33. The 50 MHz to 520 MHz input is used in the prescaled measurement mode. This input is protected from overload to withstand inputs as high as five volts rms without damage. (Overload protection is provided by a PCB mounted 2/10A fuse).

2-34. To make frequency measurements in the prescaled mode, proceed as follows:

1. Connect the input signal to the upper front panel BNC connector.
2. Press the 50 MHz to 520 MHz switch.
3. Select the desired resolution, read the measurement on the display and note the unit of measurement (i.e. MHz or kHz).

2-35. Burst Mode

2-36. The function of the burst mode is to measure the frequency of keyed RF signals having a duration of 31 milliseconds or longer. RF bursts must be longer than the gate time selected in order to achieve an accurate measurement. When using the DIRECT input the length of the burst must be at least 30 ms longer than the gate time selected, i.e., 31 ms for 1 ms gate time.

2-37. When using the PRESCALER input, multiply the gate time selected by the prescaler division factor: If the 1 ms gate time is selected the real gate time will be 4 ms for the 520 MHz Prescaler. (Add the 30 ms to these corrected gate times for the minimum burst length when using the prescalers.)

NOTE

Modification to lengthen the burst requirements to 30 ms has been added to the counter. This 30 ms delay was added to insure the count would be of the desired signal frequency and not turn-on transients.

2-38. To make measurements of keyed RF bursts, proceed as follows:

1. Connect the input signal to the appropriate front panel BNC connector (i.e. direct or prescaled input) and press corresponding FREQUENCY selection switch.
2. Press the BURST switch.
3. Select the desired resolution and read the measurement on the display. If the display reads zero, yet the GATE lamp flashes (indicating that bursts are present and measurements are being attempted), the Burst input is of shorter duration than the gate time must be selected. (Approximately 1 ms longer than selected measurable intervals).

2-39. CHANGING THE EXT TIME BASE FREQ

2-40. The Model 1920A permits the use of an external time base in substitution for the internal time base. The external time base may be 1, 5 or 10 MHz, in the range of

100 mV rms to 20V rms. Input impedance is 2,000 ohms (1000 ohms after clipping for signals above 500 mV rms). Connection is made via the rear panel BNC connector and the INT/EXT slide switch is placed in the EXT position. It may be necessary to make a jumper modification on the main PCB assembly in order to accommodate the particular external reference frequency being used. For instance, the Model 1920A is factory-jumpered for a 10 MHz external reference signal, and must be modified if a 1 MHz or 5 MHz signal is to be used.

2-41. To modify the main PCB assembly for the application of a 1 MHz or 5 MHz external reference signal, proceed as follows:

1. Remove the unit from the case by loosening the two retaining screws on the rear of the case.
2. Locate the reference jumper pads on the main PCB. (If so equipped, remove the DOU PCB assembly or the Battery PCB assembly and swing away to the side).
3. Using a suitable cutting tool, such as an X-acto, Inc. knife, sever the conductive land between the REF and 10 pads.
4. Using a piece of 22 AWG wire insert and solder a jumper between the REF pad and the 1 pad for a 1 MHz reference, or a 5 pad for a 5 MHz reference.

